**United States Naval Academy**
**Mechanical Engineering Department**

# EM320 Applied Thermodynamics

**Catalog Description:** EM320 Applied Thermodynamics **Credit:** 3 (2-2-3)

Laboratory equipment which operates on principles of thermodynamics and fluid mechanics is used to reinforce analyses and design of gas and vapor power cycles, refrigeration and air conditioning, ship and aircraft propulsion systems, combustion, energy conversion and compressible flow.

**Prerequisites:** Engineering Thermodynamics

**Textbooks:** Cengel, Y.A. and Boles, M.A., *Thermodynamics An Engineering Approach*, 4th Ed., McGraw-Hill, *Required*

**Course Director:** Assoc. Prof. R.J. Volino

**Objectives**[1]:

1. To give the student practical examples of applications of vapor and gas power cycles for power generation and propulsion. (a,b,c,e)
2. To introduce the student to compressible flow, refrigeration cycles, air conditioning, psychrometrics, and combustion. (a,b,c,e)
3. To provide the student with exposure to physical devices which operate based on principles of thermodynamics and fluid dynamics through field trips and laboratory experiments. (a,b,c,e)
4. To provide the student with design experience through open ended problems involving practical thermodynamics systems and engineering economics. (a,b,c,d,e)
5. To provide the student with experience in reporting experimental results and the results of design exercises. (d)

**Course Content:**

| No. | Topic or Subtopic | hrs. |
|---|---|---|
| 1 | Engineering Economics | 3 |
| 2 | Vapor Power Cycles | 7 |
| 3 | Gas Mixtures and Combustion | 7 |
| 4 | Gas Power Cycles | 10 |
| 5 | Compressible Flow | 6 |
| 6 | Refrigeration Cycles | 5 |
| 7 | Psychrometrics and Air Conditioning | 8 |

**Evaluation:**

| | | |
|---|---|---|
| 1. Quizzes | _x_ Yes | ___ No |
| 2. Homework | _x_ Yes | ___ No |
| 3. Exams | _x_ Yes | ___ No |

| | | |
|---|---|---|
| 4. Laboratory Reports | _x_ Yes | ___ No |
| 5. Oral Presentations | ___ Yes | _x_ No |
| 6. Design Reports/Notebooks | _x_ Yes | ___ No |
| 7. Prototypes/Demonstrations | ___ Yes | _x_ No |
| 8. Projects | ___ Yes | _x_ No |
| 9. any other evaluation tools used | ___ Yes | _x_ No |

**Acquired Abilities**[2]:

1.1 Students will demonstrate the ability to analyze and design stream power plants including systems with reheat and regeneration. (1,2,3,6)
1.2 Students will demonstrate the ability to analyze gas power cycles including those applicable to gas turbine and internal combustion engines. (1,2,3,4,6)
1.3 Students will demonstrate the ability to set up and solve problems involving aircraft propulsion. (2,3)
2.1 Students will demonstrate the ability to use compressible flow tables and relations for solution of high speed flow problems. (1,2,3,4)
2.2 Students will demonstrate the ability to predict normal shocks and compute flow quantities in nozzles and diffusers with normal shocks. (1,2,3,4)
2.3 Students will demonstrate the ability to analyze and design vapor and gas refrigeration systems. (1,2,3,4,6)
2.4 Students will demonstrate the ability to use the psychrometric chart and computer software to compute properties in air-water vapor mixtures, and use this information for analysis and design of air conditioning systems. (1,2,3,4,6)
2.5 Students will demonstrate the ability to write and balance chemical reactions for combustion problems. (1,2,3,4,6)
2.6 Students will demonstrate the ability to compute energy transfer associated with combustion. (1,2,3,4,6)
3.1 Students will demonstrate the ability to recognize physical devices and apply thermodynamic principles to explain their performance. (4)
3.2 Students will demonstrate the ability to evaluate, compute and report experimental uncertainty. (4)
4.1 Students will demonstrate the ability to use thermodynamic principles and combine multiple devices to produce complex system designs. (6)
4.2 Students will demonstrate the ability to use computer software to perform parametric and optimization studies for the evaluation of engineering designs. (4,6)
4.3 Students will demonstrate the ability to use engineering economics to determine present and annual worth, and use these principles in the evaluation and comparison of engineering designs. (1,2,3,6)
5.1 Students will demonstrate the ability to write technical reports to present designs and report experimental results. (4,6)

**Date of Latest Revision:** 28 OCT 2001

[1] Letters in parenthesis refer to the Program Objectives of the Mechanical Engineering Program.
[2] Numbers in parenthesis refer to the evaluation methods used to assess student performance.